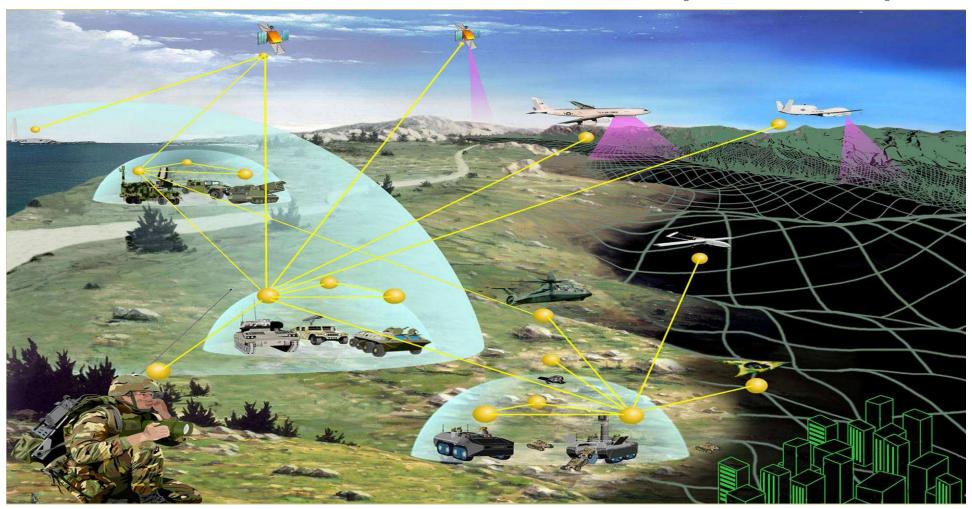
Battlespace Terrain Reasoning and Awareness- Battle Command (BTRA-BC)



A Geo-environmental Response to Net-Centric and Distributed Operations



Outline

Setting a perspective

- Programs of Record (POR) evolution and Requirements
- MDMP Process
- Net Centricity



BTRA-BC Program Mission and Assumptions

- Functional Mission: To increase the effectiveness and agility of Battle Command (BC) and the Military Decision Making Process (MDMP)through the application of geo-environmental data, information/knowledge across the greatest extent possible, across of the force
 - Battlefield Operating System of Systems..... Battle Command
 - Decision Making Process..... MDMP
 - Distributed, networked force comprised of ground and air assets

Assumptions: Underpinning such an ambitious statement

- Terrain and weather are fundamental, ubiquitous enabler/constraint to:
 - Combatant and non-combatant behavior (tactics)
 - Force, system and soldier performance
- Military operations and behaviors are not random (strategy and tactics)
 - Basis for terrain and weather relationships among missions, tactics, tasks and expected performance
- Inter-relationships provide a 1st principle enabler in BC and MDMP



Integration of Physical and Military Sciences (1990 – 2002)





Battle Command - BOS Specific

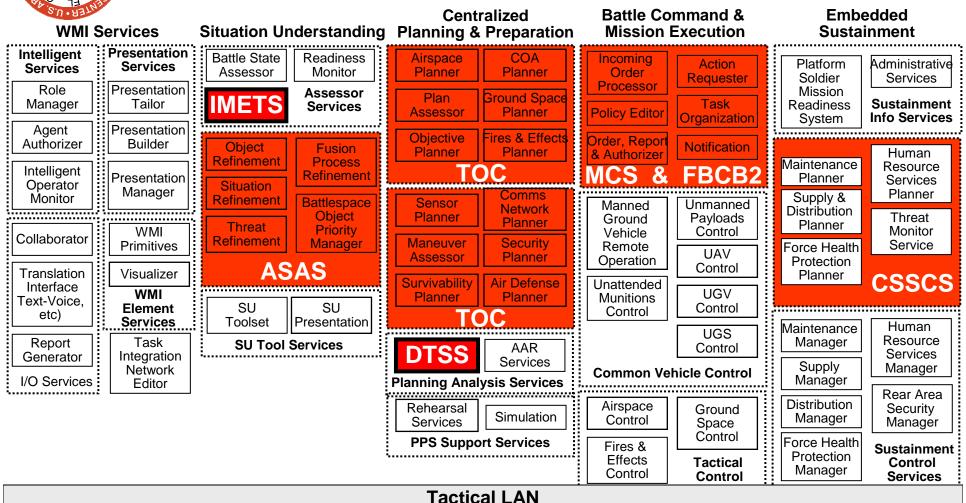
(Geospatial and Atmospheric Information and Technology)

WMI Services		Situation Understandi		Centralized Planning & Preparation		Battle Command & Mission Execution		Embedded Sustainment	
Intelligent Services	Presentation Services	Battle State Assessor Readiness Monitor	Airspace Planner	COA Planner	Incoming Order Processor	Action Requester	Platform Soldier	Administrative Services	
Role Manager	Presentation Tailor	IMETS Assessor Services	Plan Assessor	Ground Space Planner	Policy Editor	Task Organization	Mission Readiness System	Sustainment Info Services	
Agent Authorizer	Presentation Builder	Object Fusion Refinement Process	Objective Planner	Fires & Effects Planner	Order, Report & Authorizer	Notification	Maintenance	Human Resource	
Intelligent Operator Monitor	Presentation Manager	Situation Refinement Battlespace		Comms Network	Manned	Unmanned	Planner Supply &	Services Planner	
Collaborator	WMI Primitives	Threat Priority Manager	Planner Maneuver	Planner Security	Ground Vehicle Remote	Payloads Control	Distribution Planner Force Health	Threat Monitor Service	
Translation Interface	Visualizer WMI		Assessor Survivability	Planner Air Defense	Operation Unattended	UAV Control	Protection Planner		
Text-Voice, etc)	Element Services	SU SU Presentation	Planner	Planner	Munitions Control	Control	Maintenance	Human	
Report Generator	Task Integration Network	SU Tool Services	DTSS	AAR Services	Common Ve	Control	Manager Supply	Resource Services Manager	
I/O Services	Editor		Rehearsal Services	lysis Services Simulation	Airspace Control	Ground Space	Manager Distribution Manager	Rear Area Security Manager	
				PPS Support Services		Control Tactical Control	Force Health Protection Manager	Sustainment Control Services	
			Tactio	al LAN	Control		;;	00111003	



Battle Command - ABCS

(Geospatial and Atmospheric Information and Technology)



Notoriously Stovepiped.....Remained BOS Specific

Interoperability achieved via Message and Graphics Exchange

Multiple Mapping Packages



FBCB2 Geospatial Requirement

Geospatial Information and Services. The system shall accept National Imagery and Mapping Agency (NIMA) Meteorological and Oceanographic (MEDTOC) data and standard Digital Topographic Data (DTD) in standard formats without requiring second party transformation or alteration. The system shall import and use NIMA standard DTD products (raster, vector and matrix), Digital Topographic Support System (DTSS) products and updates or field expedient products provided by higher echelon resources to generate tactical decision aids. Imagery products shall be compliant with the National Imagery Transmission Format (NITF) standard. The system shall be capable of turning geospatial features and their attributes on or off for display on the common picture. The system shall enable the user to enhance selected features/attributes with value added or updated information during operations. The system shall render map vector data on the COP using the NIMA standard terrain symbology for digital products (GEOSY - MIL PRF-89045). In addition, the system shall be able to use NIMA digital products for the development of three-dimensional terrain perspectives at appropriate resolutions/scales with the system using standardized DTD exploitation tools to generate these perspectives. To facilitate system participation in a simulated environment it is required that FBCB2 be capable of importing, displaying and using CCTT and WARSIM terrain databases.

Integration of Physical and Military Sciences (2002 - 2020) Sound Utility & Representation of all to Co Interoperability

Geospatial Elngaseatary, Rattles premio and **Environmental Research Core**

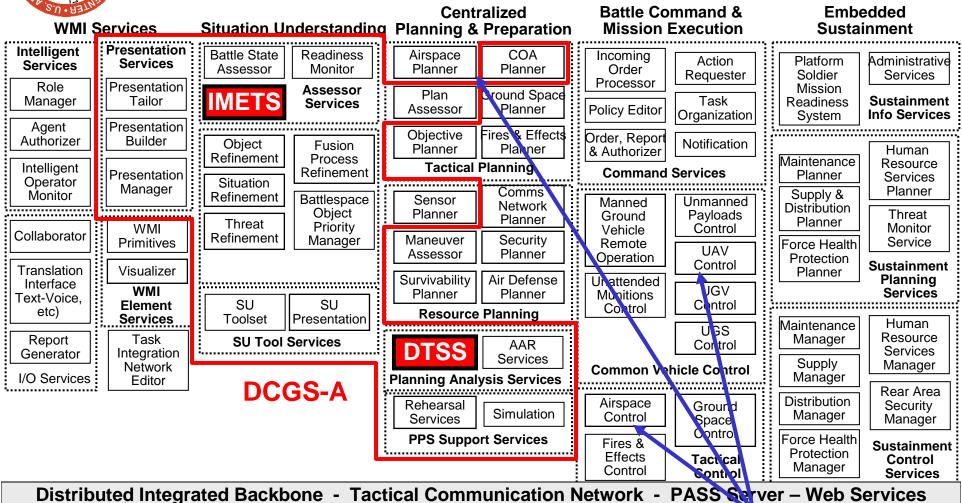






Battle Command – Future Force

(Geospatial and Atmospheric Information and Technology)



Attempt to merge functionality....Reducing Stovepipes

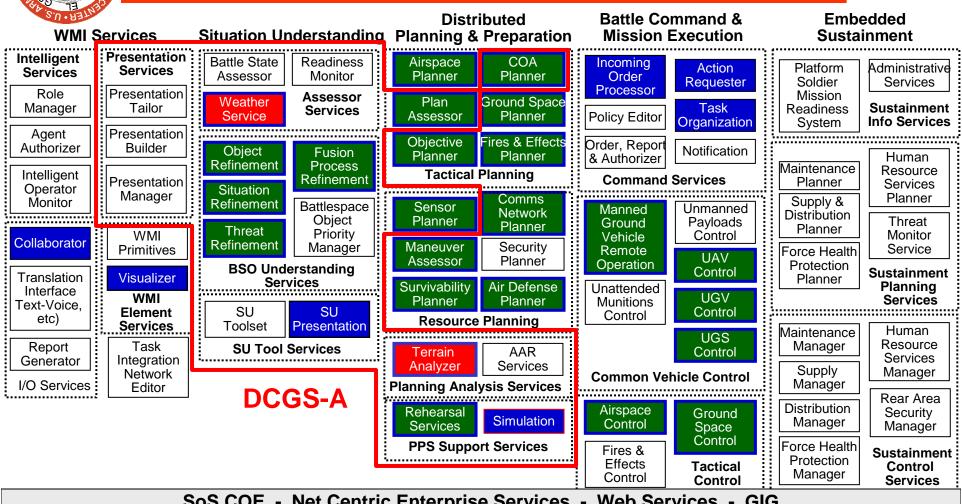
Army expands its Aviation capability - UAVs

DTSS and IMETS requirements are consumed by DCGS-A

DCGS-A becomes the tangible requirement / CONOPS for BTRA-BC

Battle Command- Net Centric (FCS)

(Geospatial and Atmospheric Information and Technology)



SoS COE - Net Centric Enterprise Services -Web Services - GIG

Interactive / Computational Info Services **Geo-based Decision Tools** GeoBML and JC3IEDM

DCGS-A is at BDE FCS Battle Command Appliqué is on 470 Vehicles in the BDE What about the Joint fight?



FCS Terrain Analyzer Requirements

Basic Terrain Analysis Functionality - OCOKA

- Terrain Data Importer
 - NGA compatible base and Updates
- Terrain Exposure Factor
 - Cover and Concealment
- Terrain Traversability
 - Mobility
 - Obstacles
 - Weather
 - Cultural and Man-made features
- Terrain Discernability
 - Key Terrain and Site selection
 - Weather
- Terrain Line of Sight
 - LOS
 - Obstacles / physical impediments / DEM
 - Weather
 - Cultural and Man-made features

- Terrain Intervisibility
 - Observability
 - Weather
 - Cultural and Man-made features
- Terrain Obstacles
 - Type, size and location
- Terrain Avoidance
 - UAVs
- Tactical Data Incorporation
 - Threat and non-combatant location and terrain updates
- Terrain Effects
 - RF Propegation
- Dynamic Terrain Analysis
 - Weather
 - Explosives

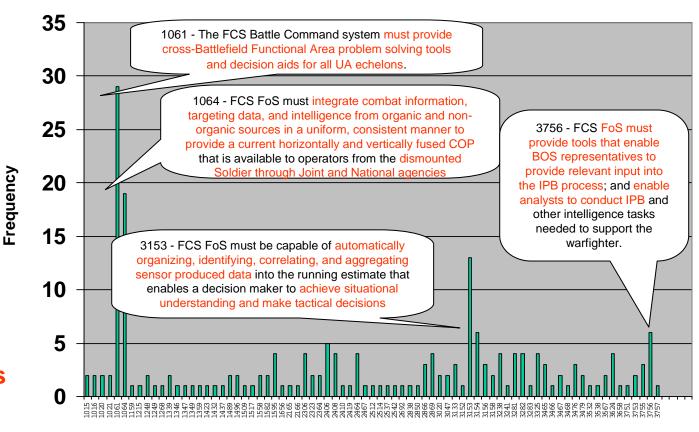


FCS Derived Requirements – C2

207 ORD Citations
Enabled by Terrain &
Weather Information
Integrated into
C2 Processes

.... and Mission
Application Services
Defined by the LSI's
Request for Proposals

Terrain and Weather Relationships to FCS ORD for C2



C2 ORD Citations

Terrain and Weather Info.... Ubiquitous Within the FCS Architecture

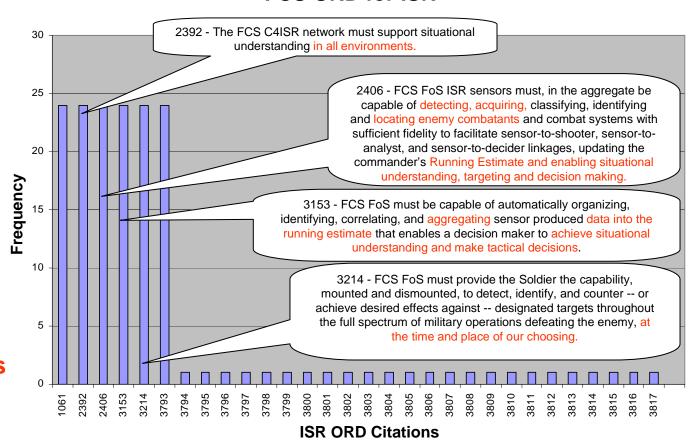


FCS Derived Requirements – ISR

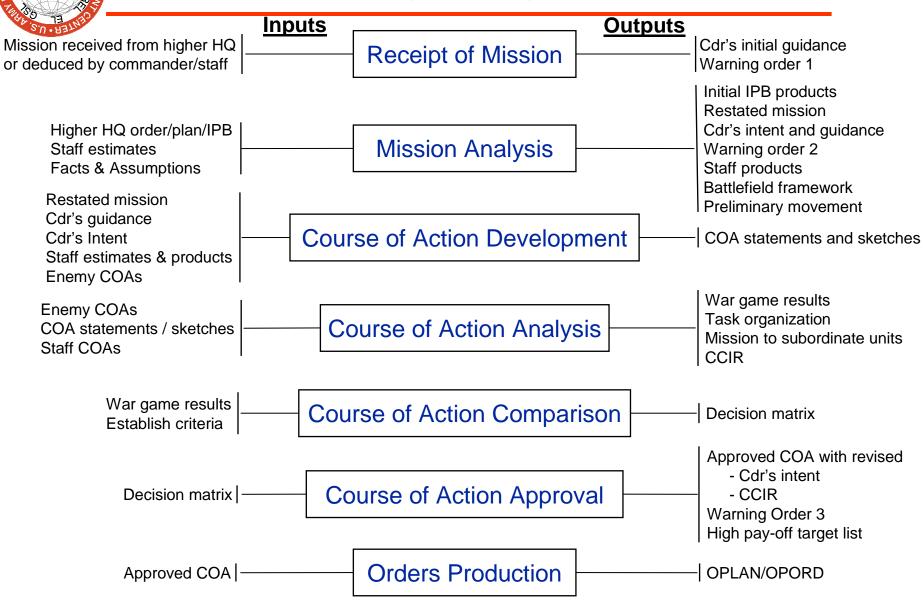
168 ORD Citations
Enabled by Terrain &
Weather Information
Integrated into
ISR Processes

.... and Mission
Application Services
Defined by the LSI's
Request for Proposals

Terrain and Weather Relationships to FCS ORD for ISR

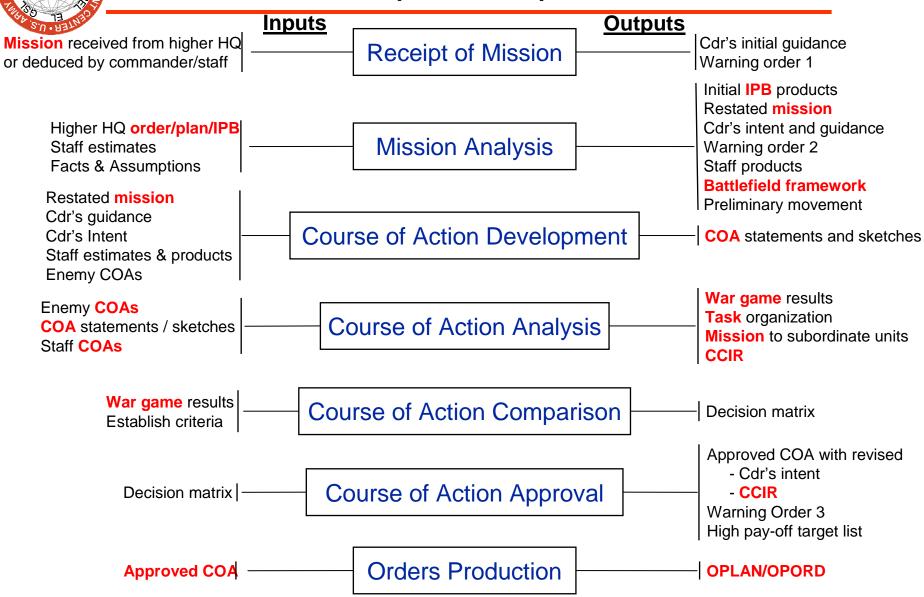


Military Decision Making Process (MDMP) (FM 101-5)



Stable doctrinal process, trained to the force system independent

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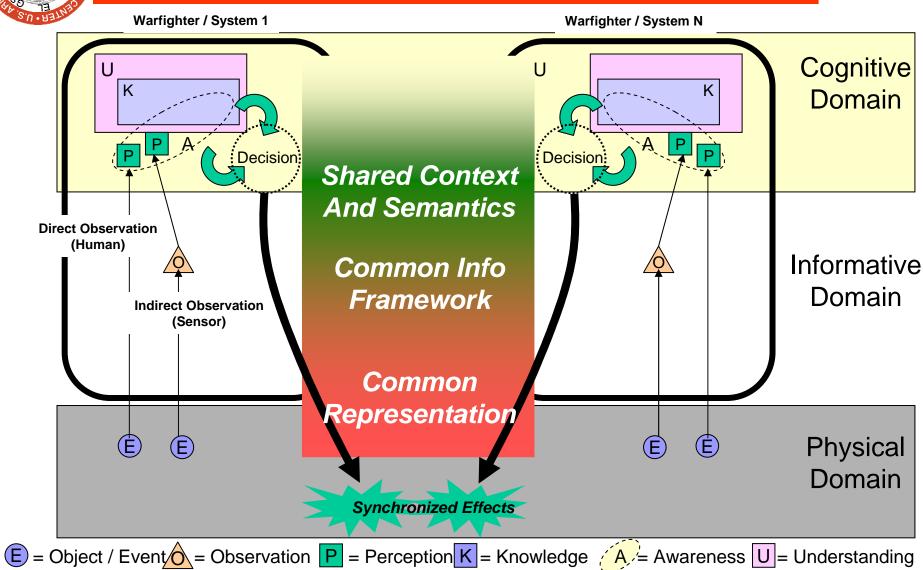
Distributed BC Considerations

- Bandwidth is finite...relatively
 - Consider the impact of actionable geospatial information products on the network
 - Minimize the size of information products and frequency of transmissions
 - Achieve the best ratio of information value to bandwidth.
- Computation, storage and soldier expertise varies across the force
 - Consider the data, information, other support systems and soldier expertise that you require at the point of decision (e.g. force structure)
 - Consider the nature and quantity of interactions from the point
- Metcalf's Law
 - Real potential and value in each transaction with respect to the MDMP
 - Maximize OHIO...information should be ready to use in the MDMP
 - N-way transactions create the most value
 - Design to the broadest user set across Battle Command tasks / processes

SEARCH AND CERT OF MEN

Distributed BC Considerations

(Interoperability)





Summary of Factors Influencing BTRA-BC Program

Battle Command - Battlefield Operating Systems

- No strong CONOPS.....set of requirements from TRADOC
- Army and Joint Programs of Record (PORs) with overlapping mission, process but competing operational and architectural objectives (ABCS.....DCGS-A.....FCS)
 - Geo-environmental is not central in any POR except DTSS and IMETS (DCGS-A)
 - Service Oriented Architectures Web Services Client Server Application Services
 - NGA's Commercial Joint Mapping Toolkit (C/JMTK) addresses Joint Geo-environmental functionality
- Expansion of Army Aviation operations (UAV) and BC
 - Support to ground forces

MDMP

- Stable, trained process, independent of PORs
- Founded upon mission, task, activity, COA and wargaming

Tenets of Network Centric Operations

- Interoperability is essential
 - · Consistent representation of the physical environment and effects
 - Common Semantics and Framework for Information Sharing
- Competition for bandwidth is increasing
 - Information abstraction
- Increasing capability and decision making is pushed to lower echelons
 - Presentation and interaction with a diminishing force structure and staffing must insure information value
 - Greater automation and decision tools



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BTRA-BC Program Mission and Technical Objectives

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 - Distributed, networked force comprised of ground and air assets

• Technical Objectives and Challenges:

- Automated Information Generation and Decision Tools
 - Utility within the MDMP process and the functions of Battle Command
 - Integration terrain, weather and atmospheric effects on tactics, platforms, systems and soldiers
 - Common Computational Representation
- Interoperability
 - Syntactic, Lexical and Semantic
- Operationally viable information architecture BDE and Below
 - Near-term (Components and Web Services) CJMTK, DTSS and DCGS-A
 - Far Term (Application Servers) to empower platform level FBCB2 and FCS



Technical Program Evolution

Platform Effects

Weather Analysis and Structural Organization

Atmospheric State and Sensor Effects

Sensor Effects

Terrain / Weather Temporal Effects at the Boundary Layer

Terrain State and Mobility Effects

Terrain Analysis and Structural Organization

Spatial Organization (unit / task)

Temporal Organization (unit / platform)



Information-Decision Tool Framework

(Is it a System?)

Command and Control

- 1) Course of Action Analysis
- 2) Dynamic Planning
- 3) Execution / Plan Assessment
- 4) Robotic Maneuver

Intelligence

- 1) Intel Preparation of the Battlespace
- 2) Predictive Threat Assessment
- 3) Collection / Asset Management

Network Services or "Common" Embedded Applications

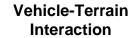
Predictive Tactical Analysis

Situation Analysis

Dynamically Responsive 4-Dimensional Tactical Chessboard

Vehicle and Class Speeds Digital- Interactive Maneuver Graphs

Mission to Task Relationship Structures Regional Sensor P(d) (IR, Acoustic & Seismic)



Platform-Atmosphere Interaction

Spatial and 3D Tactical Spatial Objects

Multi- Relational Attribution

State of the Ground – Atmosphere Transfer

Sensor Physics

Mobility and Maneuver
Sciences
Air and Ground

Geospatial and Carto Sciences

Physical / Atmospheric Sciences



Current Spatial Objects for geoBML

Tier 1 Products (Terrain/Military Context)

Natural Obstacles

Concealment

Fields of Fire

Cross Country Movement

Maneuver Network

Mobility Corridors

Chokepoints

Tier 2 products (Mission Context)

/Tier 3 products (Planned)

Avenues of approach

Assembly Areas

Engagement Areas

Tier 2 Routes

Battle Positions

Attack positions

Axis of Advance

Indirect Fire Firing Position

Assault Positions

Attack by Fire Positions

Drop Zones

Helicopter Landing Zones



Interoperability

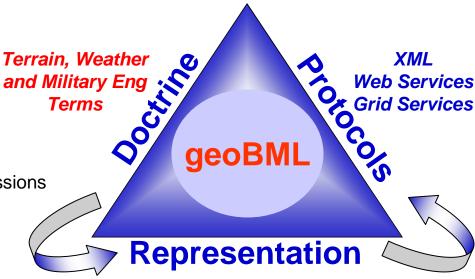
(geospatial Battle Management Language (geoBML))

geoBML is an Unambiguous Language

- Both domain specific and cross-cutting
- Defined by the role of actionable geo-information in the C2

Provides Unification...across

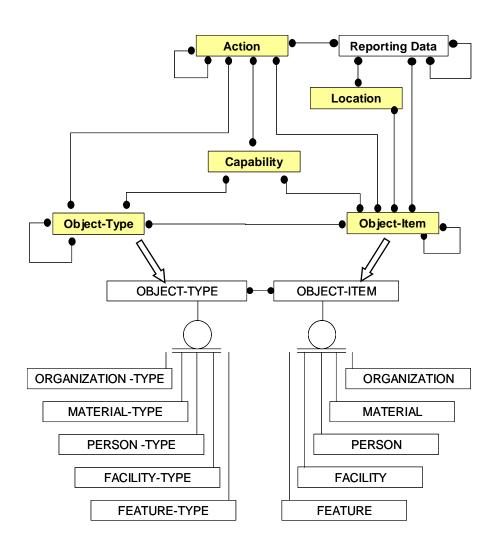
- Doctrine and terms
 - Explicit vocabulary and grammar
 - Specific context mapped to operations, missions and tasks
- Explicit Representation
 - Consistent extension to the C2IEDM
 - Standard framework and exchange model
 - Computational structure
 - Both necessary and sufficient for shared, common understanding
- Protocols
 - Explicit structure for transmission / sharing



Geo-Environmental Extension to Command & Control Information Exchange Data Model (C3IEDM)

Explicit Computational Representation For Actionable Geospatial Information

- Provides Core C2 Semantics
- Comprehensive
- Very well documented
 - Tables
 - Attributes
 - Relations
- Allows for Extension





Architectural Framework

(Terrain and Weather)

Planning and Preparation
Situation Understanding

C4ISR Sensor Fusion

C2 Training / Modeling and Simulation

Fusion Level Commercial Joint Mapping Toolkit Net Centric Enterprise Services Enterprise GIS Architecture Tier Exploitation Technology Analytic Technologies **Decision Tools Decision Tools** N **Photogrammetry Geographic Context Tactical Context Mission Context** K Situational Context **And Spectral** D N **Technology** Representation Representation Information Knowledge E 0 R 0 Format/Encoding Format/Encoding Format/Encoding Format/Encoding Format / Encoding W W S R T Models C Models **Models** Models M D E T

0

Bandwidth

S

Actionable Information

G

D

G



Information Architecture

(FY07 - 08)

Engines and Application Services

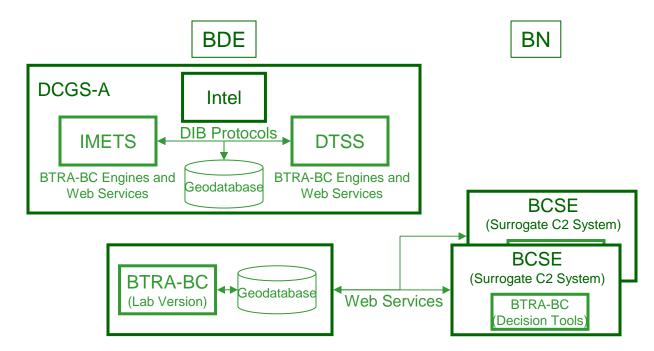
- Individual Components Information Generation and Decision Tools
- Aggregated into Common Application Services where appropriate

System Wide Database Design

- Consistent I/O for flexible force structure implementation
- Products and Services their products and attribution will be mapped to JC3IEDM

Web Services Implementation

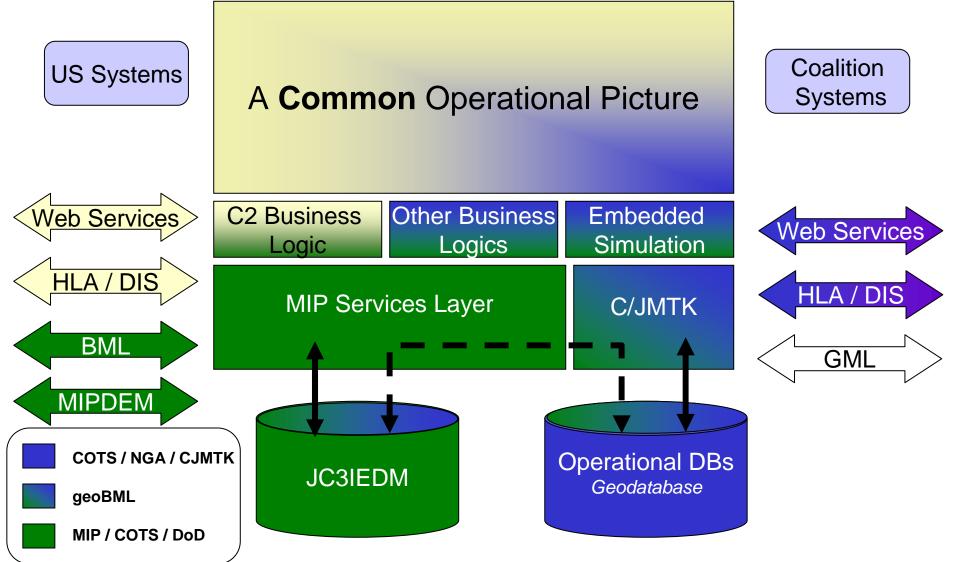
Most acceptable delivery for DTSS / DCGS-A and C/JMTK





Information Architecture

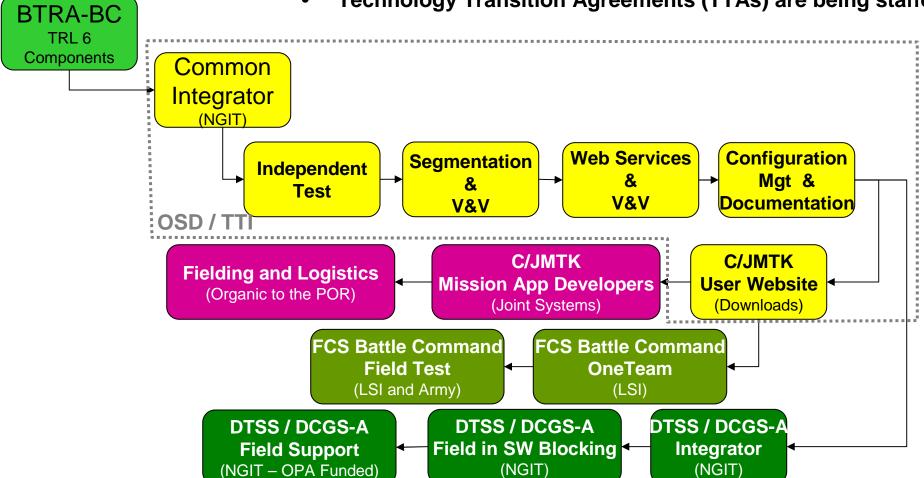
(FY09 - 10)





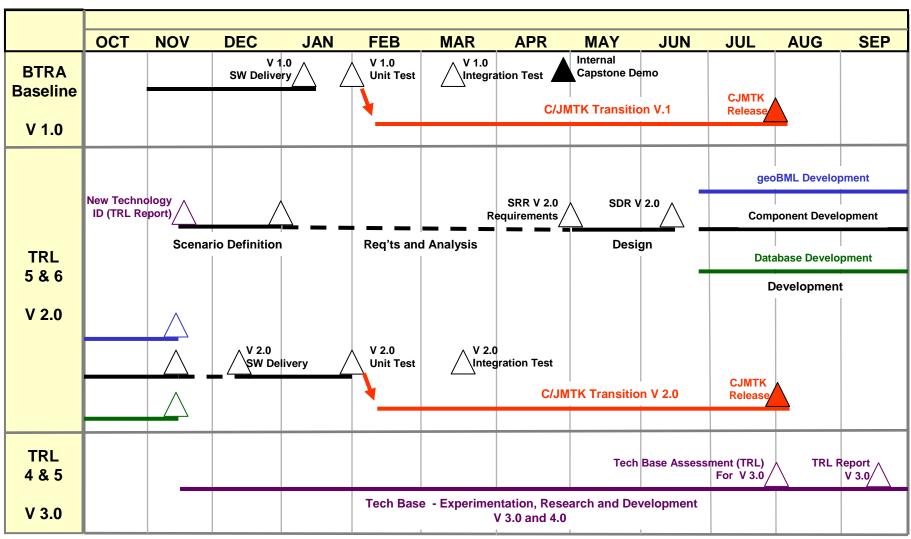
Transition Approach

- Leverage common frameworks
 - Technology
 - GIS base tools and CJMTK
 - System Integrators of the Programs of Record
- Technology Transition Agreements (TTAs) are being staffed





(Single Cycle Overview)



Performance via Process and Communication



We have a Strong Base

BTRA Team

- Consistent, actionable terrain/weather based information
 - 1. Terrain effectively organizes the battlefield with some tactical context (e.g. Mission or Task) and provides spatial discrimination
 - 2. Weather / terrain effects could generate actionable information with respect to mobility and sensor performance
 - 3. Computationally relate information structures from hypothesis 1 and 2
 - 4. Complexity of terrain based organization can support situation and threat analysis
 - 5. Shared awareness founded in information employing a common semantic is optimal
 - Human to human / Machine to human / Machine to Machine
 - 6. Terrain tools could be organized / configured in a distributed force structure
 - Service / Embedded
 - 7. Well engineered terrain information representation (s) could support a multitude of BFAs / BOSs
 - 8. Information representation(s) could be pushed to the edge of the force
 - 9. To what degree can automation can enable the force.... Where is the line

ARL

- IMETS insight and IWEDA Tactical Decision Aids
 - 1. Incredibly deep rule base
 - 2. Efficient algorithms

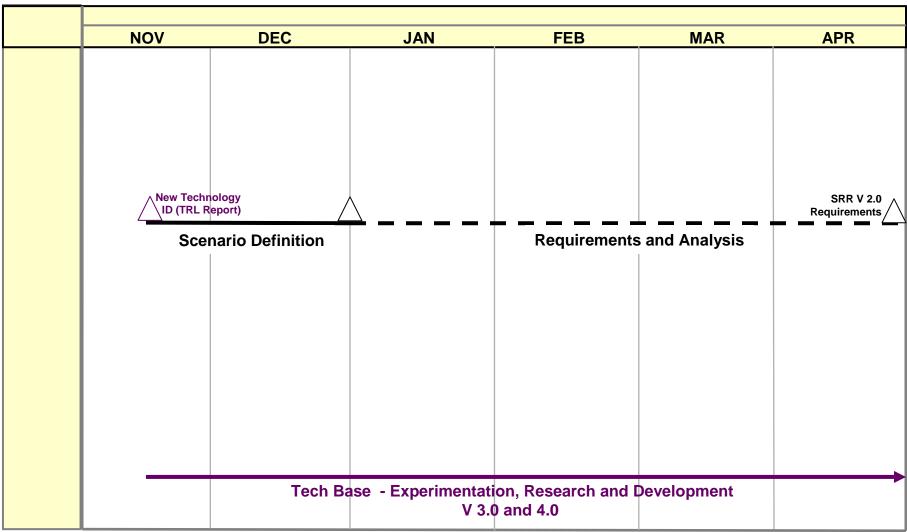


Closing Remarks

- - My hope that these next 3 days will be an opportunity to
 - Renew existing professional relationships
 - · Identify team members with similar and dissimilar interests
 - Come together for a common purpose <u>based upon trust</u>
- Moving forward, we will face challenges and adversity
 - Technical and/or competing approaches
 - Institutional cultures and individual personalities
 - Challenges imposed by geography
- As a result, we are spending most of our time together ensuring that the process can overcome these challenges
- Process can not overcome the Five Dysfunctions of a Team (by Patrick Lencioni)
 - Inattention to results
 - Fear of conflict
 - Absence of trust
 - Lack of Commitment
 - Avoidance of acccountability

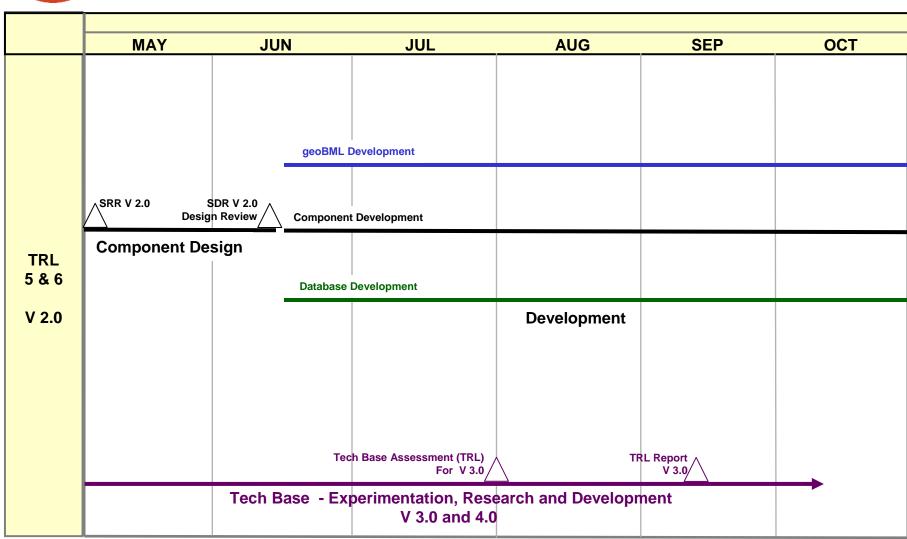


(Single Cycle Overview)





(Single Cycle Overview)





(Single Cycle Overview)

